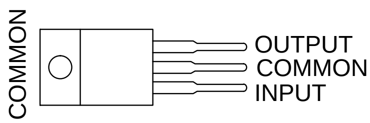
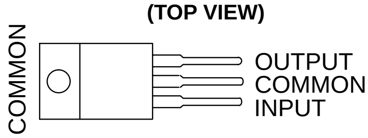
TL780 SERIES POSITIVE-VOLTAGE REGULATORS

- ±1% Output Tolerance at 25°C
- ±2% Output Tolerance Over Full Operating Range
- Thermal Shutdown
- Internal Short-Circuit Current Limiting
- Pinout Identical to μA7800 Series
- Improved Version of μA7800 Series

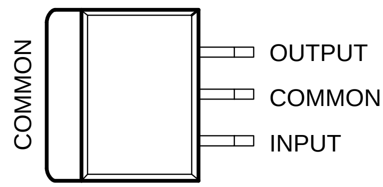
KC (TO-220) PACKAGE
(TOP VIEW)



KCS (TO-220) PACKAGE
(TOP VIEW)



KTE PACKAGE
(TOP VIEW)



description/ordering information

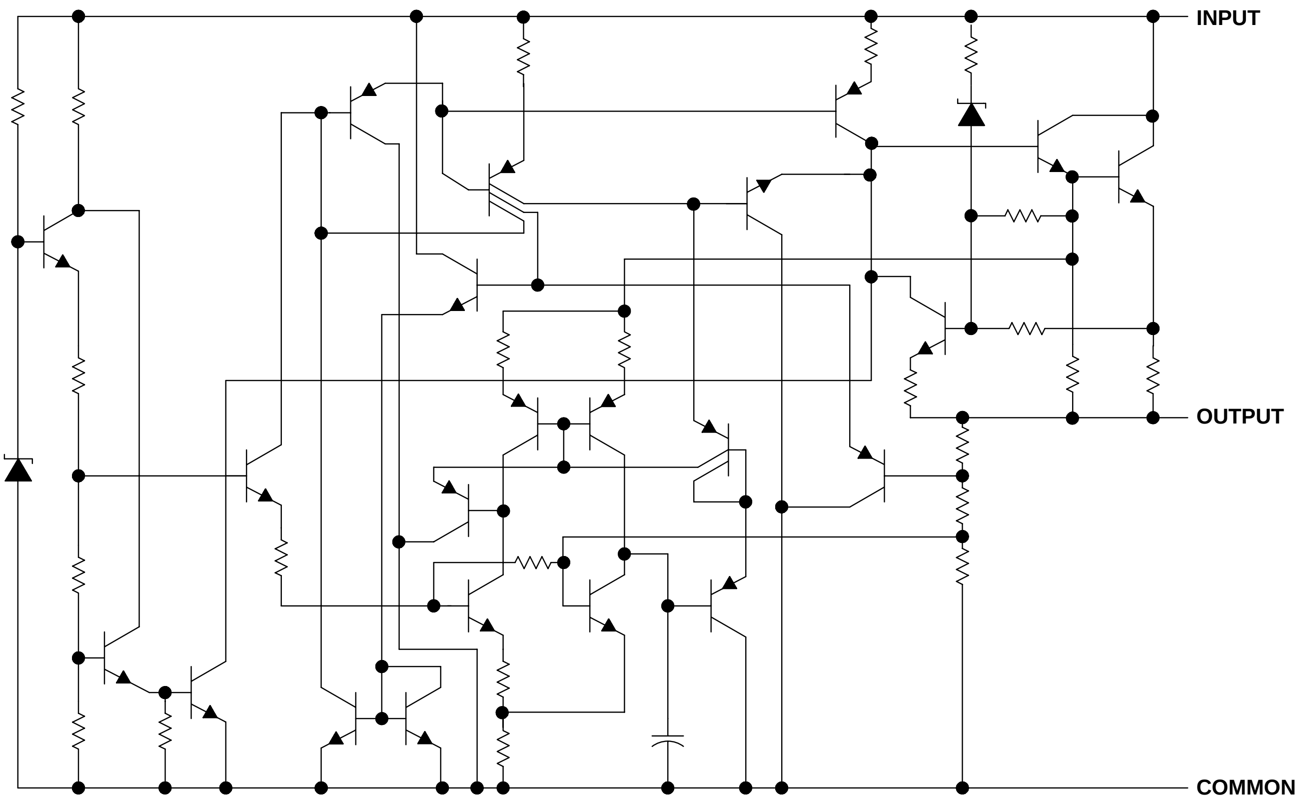
Each fixed-voltage precision regulator in the TL780 series is capable of supplying 1.5 A of load current. A unique temperature-compensation technique, coupled with an internally trimmed band-gap reference, has resulted in improved accuracy when compared to other three-terminal regulators. Advanced layout techniques provide excellent line, load, and thermal regulation. The internal current-limiting and thermal-shutdown features essentially make the devices immune to overload.

ORDERING INFORMATION

T_J	V_O TYP (V)	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 125°C	5	Power Flex (KTE)	Reel of 2000	TL780-05CKTER	TL780-05C
		TO-220 (KC)	Tube of 50	TL780-05CKC	TL780-05C
		TO-220, short shoulder (KCS)	Tube of 20	TL780-05CKCS	
	12	TO-220 (KC)	Tube of 50	TL780-12CKC	TL780-12C
		TO-220, short shoulder (KCS)	Tube of 20	TL780-12CKCS	
	15	TO-220 (KC)	Tube of 50	TL780-15CKC	TL780-15C
		TO-220, short shoulder (KCS)	Tube of 20	TL780-15CKCS	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

schematic



absolute maximum ratings over operating temperature range (unless otherwise noted)†

Input voltage, V_I . . . . 35 V
Operating virtual junction temperature, T_J . . . . 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . 260°C
Storage temperature range, T_{stg} . . . . –65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

package thermal data (see Note 1)

PACKAGE	BOARD	θ_{JC}	θ_{JA}
Power Flex (KTE)	High K, JESD 51-5	3°C/W	23°C/W
TO-220 (KC/KCS)	High K, JESD 51-5	3°C/W	19°C/W

NOTE 1: Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

recommended operating conditions

			MIN	MAX	UNIT
V_I	Input voltage	TL780-05C	7	25	V
		TL780-12C	14.5	30	
		TL780-15C	17.5	30	
I_O	Output current			1.5	A
T_J	Operating virtual junction temperature		0	125	°C

electrical characteristics at specified virtual junction temperature, V_I = 10 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J†	TL780-05C MIN	TYP	MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, P ≤ 15 W, V_I = 7 V to 20 V	25°C	4.95	5	5.05	V
		0°C to 125°C	4.9		5.1	
Input voltage regulation	V_I = 7 V to 25 V	25°C		0.5	5	mV
	V_I = 8 V to 12 V			0.5	5	
Ripple rejection	V_I = 8 V to 18 V, f = 120 Hz	0°C to 125°C	70	85		dB
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		4	25	mV
	I_O = 250 mA to 750 mA			1.5	15	
Output resistance	f = 1 kHz	0°C to 125°C		0.0035		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		0.25		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		75		µV
Dropout voltage	I_O = 1 A	25°C		2		V
Input bias current		25°C		5	8	mA
Input bias-current change	V_I = 7 V to 25 V	0°C to 125°C		0.7	1.3	mA
	I_O = 5 mA to 1 A			0.003	0.5	
Short-circuit output current		25°C		750		mA
Peak output current		25°C		2.2		A

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-µF capacitor across the input and a 0.22-µF capacitor across the output.

electrical characteristics at specified virtual junction temperature, V_I = 19 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_J†	TL780-12C MIN	TL780-12C TYP	TL780-12C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, V_I = 14.5 V to 27 V	P ≤ 15 W,	25°C	11.88	12	12.12	V
			0°C to 125°C	11.76		12.24	
Input voltage regulation	V_I = 14.5 V to 30 V		25°C		1.2	12	mV
	V_I = 16 V to 22 V				1.2	12	
Ripple rejection	V_I = 15 V to 25 V,	f = 120 Hz	0°C to 125°C	65	80		dB
Output voltage regulation	I_O = 5 mA to 1.5 A		25°C		6.5	60	mV
	I_O = 250 mA to 750 mA				2.5	36	
Output resistance	f = 1 kHz		0°C to 125°C		0.0035		Ω
Temperature coefficient of output voltage	I_O = 5 mA		0°C to 125°C		0.6		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz		25°C		180		μV
Dropout voltage	I_O = 1 A		25°C		2		V
Input bias current			25°C		5.5	8	mA
Input bias-current change	V_I = 14.5 V to 30 V		0°C to 125°C		0.4	1.3	mA
	I_O = 5 mA to 1 A				0.03	0.5	
Short-circuit output current			25°C		350		mA
Peak output current			25°C		2.2		A

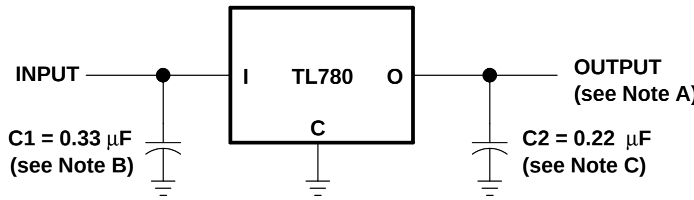
† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.22-μF capacitor across the output.

electrical characteristics at specified virtual junction temperature, V_I = 23 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_J†	TL780-15C MIN	TL780-15C TYP	TL780-15C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, V_I = 17.5 V to 30 V	P ≤ 15 W,	25°C	14.85	15	15.15	V
			0°C to 125°C	14.7		15.3	
Input voltage regulation	V_I = 17.5 V to 30 V		25°C		1.5	15	mV
	V_I = 20 V to 26 V				1.5	15	
Ripple rejection	V_I = 18.5 V to 28.5 V,	f = 120 Hz	0°C to 125°C	60	75		dB
Output voltage regulation	I_O = 5 mA to 1.5 A		25°C		7	75	mV
	I_O = 250 mA to 750 mA				2.5	45	
Output resistance	f = 1 kHz		0°C to 125°C		0.0035		Ω
Temperature coefficient of output voltage	I_O = 5 mA		0°C to 125°C		0.62		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz		25°C		225		μV
Dropout voltage	I_O = 1 A		25°C		2		V
Input bias current			25°C		5.5	8	mA
Input bias-current change	V_I = 17.5 V to 30 V		0°C to 125°C		0.4	1.3	mA
	I_O = 5 mA to 1 A				0.02	0.5	
Short-circuit output current			25°C		230		mA
Peak output current			25°C		2.2		A

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.22-μF capacitor across the output.

PARAMETER MEASUREMENT INFORMATION



NOTES: A. Permanent damage can occur when OUTPUT is pulled below ground.
B. C1 is required when the regulator is far from the power-supply filter.
C. C2 is not required for stability; however, transient response is improved.

Figure 1. Test Circuit

APPLICATION INFORMATION

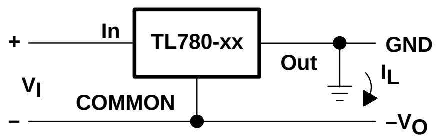


Figure 2. Positive Regulator in Negative Configuration (V_I Must Float)

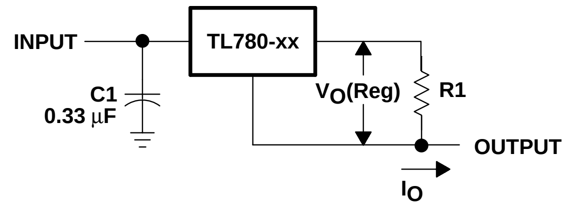


Figure 3. Current Regulator

operation with a load common to a voltage of opposite polarity

In many cases, a regulator powers a load that is not connected to ground, but instead, is connected to a voltage source of opposite polarity (e.g., operational amplifiers, level-shifting circuits, etc.). In these cases, a clamp diode should be connected to the regulator output as shown in Figure 4. This protects the regulator from output polarity reversals during startup and short-circuit operation.

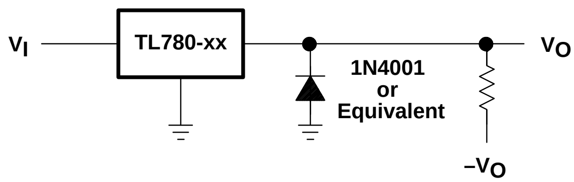


Figure 4. Output Polarity-Reversal-Protection Circuit

reverse-bias protection

Occasionally, the input voltage to the regulator can collapse faster than the output voltage. This, for example, could occur when the input supply is crowbarred during an output overvoltage condition. If the output voltage is greater than approximately 7 V, the emitter-base junction of the series pass element (internal or external) could break down and be damaged. To prevent this, a diode shunt can be employed, as shown in Figure 5.

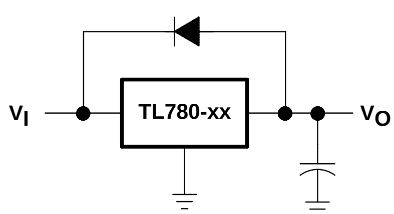
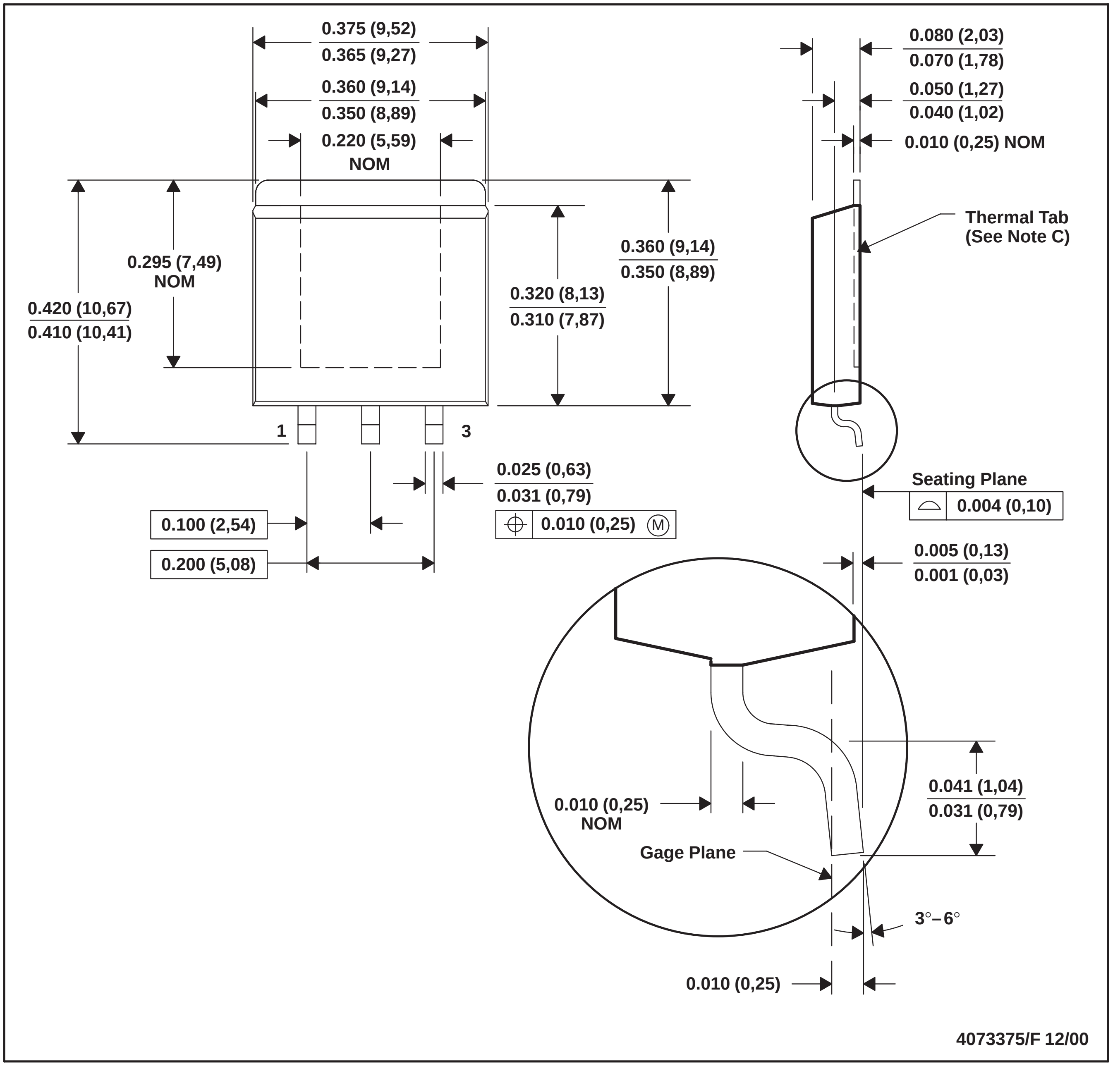
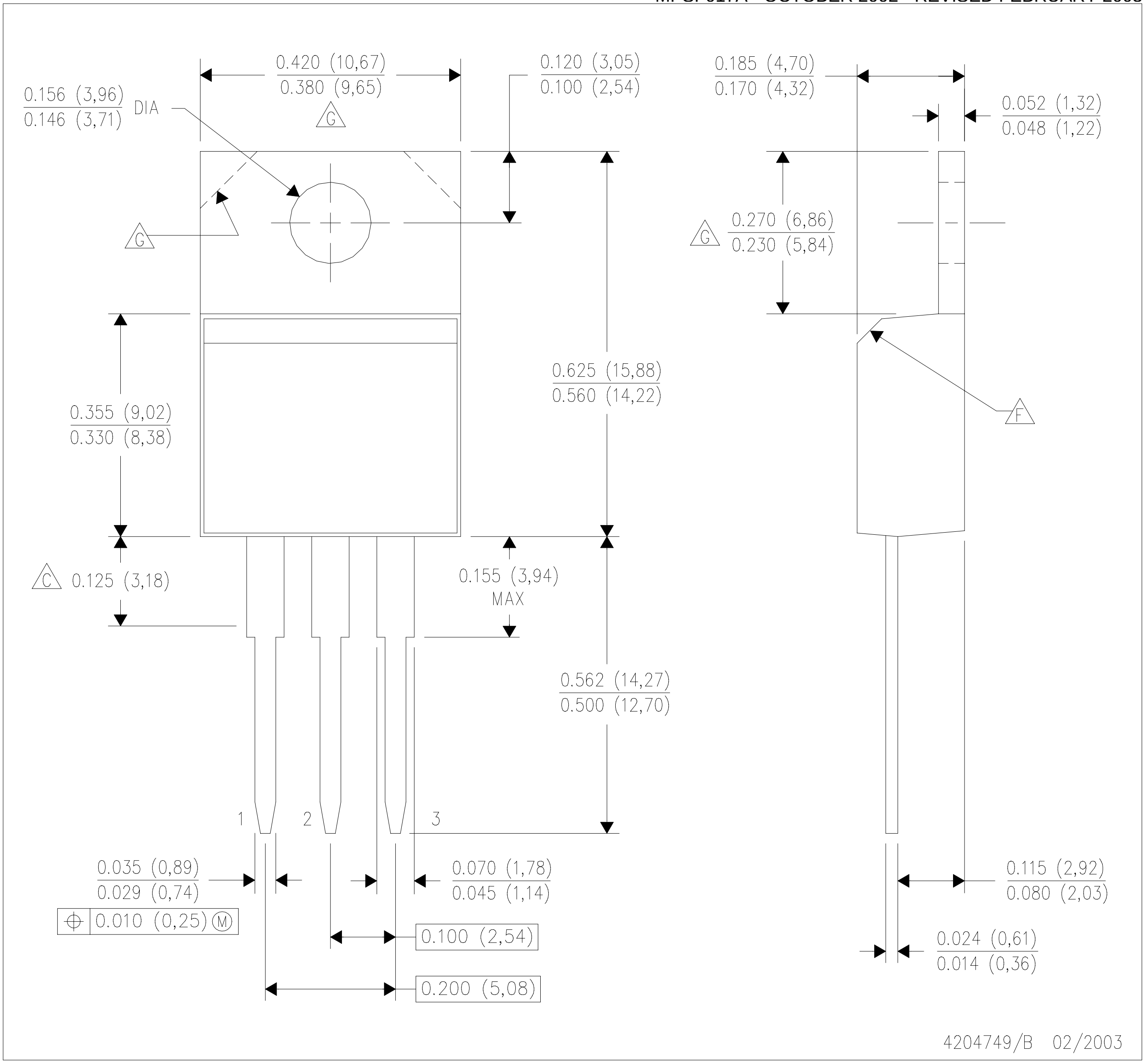


Figure 5. Reverse-Bias-Protection Circuit

KTE (R-PSFM-G3) **PowerFLEX™ PLASTIC FLANGE-MOUNT**



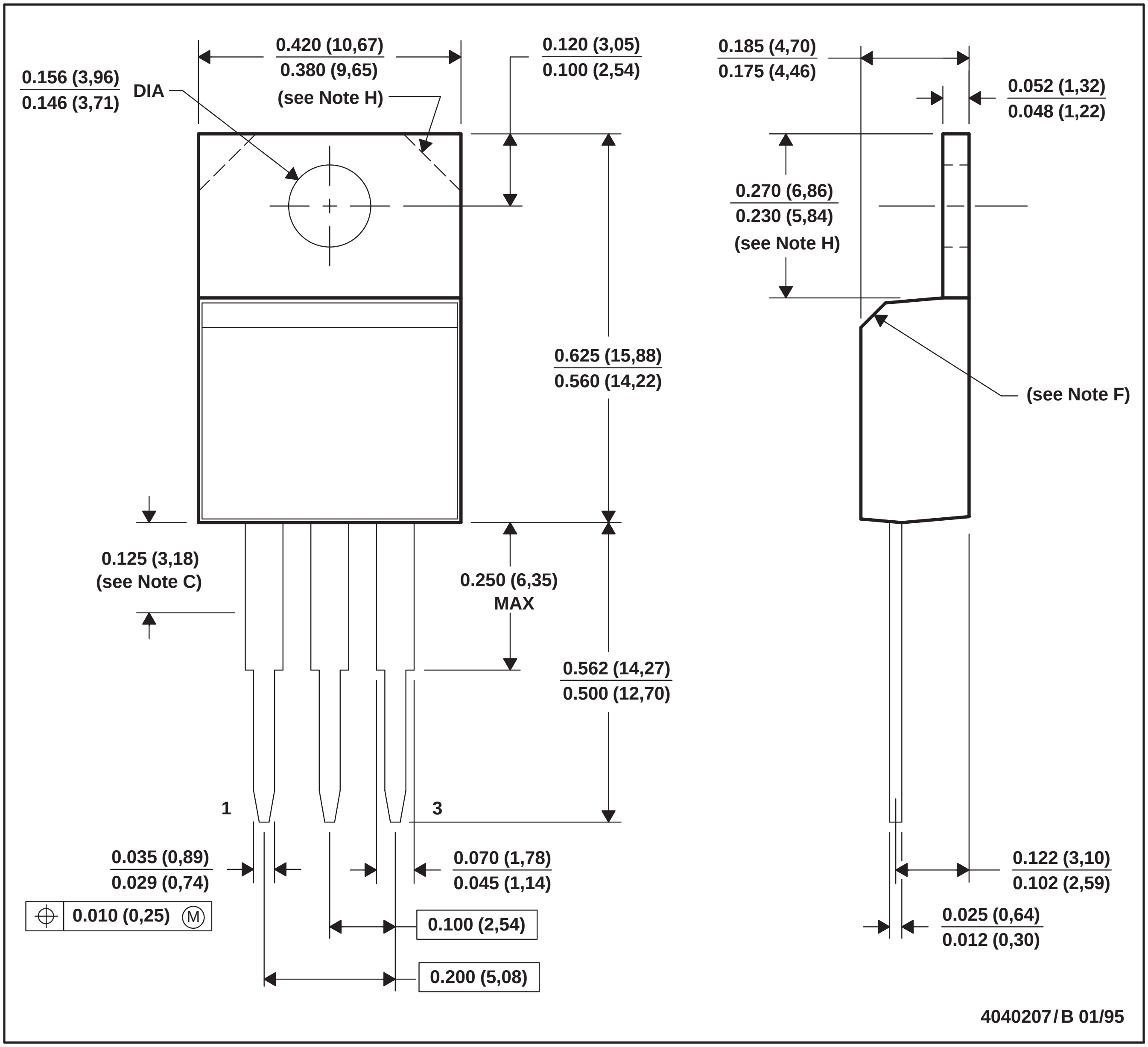
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the thermal tab.
D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
E. Falls within JEDEC MO-169



NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Lead dimensions are not controlled within this area.
- D. All lead dimensions apply before solder dip.
- E. The center lead is in electrical contact with the mounting tab.
- F. The chamfer is optional.
- G. Tab contour optional within these dimensions.
- H. Falls within JEDEC TO–220 variation AB.

SCALE	SIZE A	4204749	REV B	SHEET 2/3

KC (R-PSFM-T3) PLASTIC FLANGE-MOUNT PACKAGE



NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Lead dimensions are not controlled within this area.
- D. All lead dimensions apply before solder dip.
- E. The center lead is in electrical contact with the mounting tab.
- F. The chamfer is optional.
- G. Falls within JEDEC TO-220AB
- H. Tab contour optional within these dimensions

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